AMENDMENT TO THE DRAWINGS

Attached are "REPLACEMENT SHEETS" of the drawings. The "REPLACEMENT SHEETS" includes FIGS. 1-21 and replaces the original drawing sheets that included FIGS. 1-21.

Attachment: Replacement Sheets

WRITTEN DESCRIPTION

The amended paragraphs of the written description presented below replace all the prior versions of the corresponding paragraphs of the written description in this application.

[0008] A typical method illustrated in FIG. 1 for code synchronization compares 7 the output $|y_t|$ of a matched filter 1 or of a correlator to a predetermined threshold 3. Code synchronization 5 is said to be achieved [[5]] when the matched filter 1 output magnitude 1 exceeds a pre-determined threshold 3. If the matched filter output magnitude does not exceed a pre-determined threshold 3, the system continues searching 10. Exceeding this threshold usually coincides with the maximum output from the matched filter and indicates the presence of the code at the given time offset (i.e., the code starts at t-N+1). The threshold may be selected to achieve a desired probability of false alarm (i.e., the probability of detecting the code at a wrong offset).

[0010] Other variants for code acquisition use multi-dwell and multi stage strategies. See e.g. A. J. Eynon, and T. C. Toer, A Comparison of ~~Mulitple~~ Multiple Dwell Cell Testing Strategies in Serial Search Direct Sequence Spread Spectrum Code Acquisition, Proc. of Milcom '95, Vol1, Sand Diego, Calif. pp. 357-361; H. Holma and A Toskala, WCDMA for UTMS, John Wiley and Sons, 2000. These references and all other references herein are hereby incorporated by reference. In a multi-dwell code acquisition approach, the search is done in multiple steps. Generally, each step uses an increasing threshold level and the matched filter output is averaged over a longer period of time before comparison to the threshold. If the averaged value does not exceed the threshold at a given step, the code acquisition algorithm restarts with a different candidate, otherwise it proceeds to the

next step until the last step. When the averaged value for the last step exceeds the pre-determined threshold, the code acquisition is said to be achieved.

[0013] One problem with the use of matched filters for code detection is that they generally require a large amount of computation. This is particularly limiting when the code length is large. In this case, an alternative approach may employ a correlator code detector. FIG. 4 shows the functionality of the correlator in block diagram form. As in FIG. [[1]] 3, z^{-1} represents a delay element 25, however, unlike the matched filter, the correlator only utilizes one delay element 25 in an accumulator configuration 35. The incoming sequence $r_{b,t}$ 23 is first multiplied 27 with the sequence $c_{b,N-1+t-T}^*$, 37 where b is the code number, N is the code length, t is the time index, and T is the time where the correlator output is observed (sampled). The result of the multiplication is then accumulated 39. The accumulator 35 is reset at time t=T-N+1 41 and sampled at time t=T 43 to yield y_t 45.

[0017] The oscillator in a wireless network base-station and the local oscillator in a mobile terminal rarely oscillate at the same frequency. Because of this frequency offset between the base-station and the mobile terminal, the received signal r_t at the t^{th} time index (sample) may be represented as: $r_t=c_{b,t \bmod N}e^{j\Delta wtTs}$ where T_s represents the sampling interval (time between two ~~consequtive~~ consecutive samples), Δw represents the frequency offset, and $e^{jx}=\cos x+\sqrt{-1}\sin x$. A "frequency recovery loop" is typically used to drive the frequency difference to zero. Once Δw is driven to zero, so-called coherent detection can take place. In the absence of this (when $\Delta w\neq 0$), detection can still take place but it is less efficient and is referred to as non-coherent detection.

[0033] The other approach is to use the DD output metric in a phase locked loop (PLL) as illustrated in FIG. 5. Id. The DD output X(1) 53 is an indication of the sign and magnitude of the frequency offset. A non-linear device [[55]] 54 might be employed to obtain only the direction of the rotation in order to simplify the implementation. The output of the non-linear device may be filtered by a [[band]] low pass filter [[57]] 55 to remove the noise and accumulated 57 to provide an estimate of the frequency offset. The frequency offset is used to control a Direct Digital Frequency Synthesizer (DDFS) 59. A DDFS 59 produces at its output a sinusoid with a frequency controlled by the input frequency offset value.

[0034] This sinusoid is used to derotate [[60]] 61 the input signal r_j 63. The derotated signal 65 is used as the input to the DD 51. It can be easily seen that at the beginning, when the frequency offset estimate is not accurate, the DD will detect a frequency offset at its output. This non-zero output then increases/decreases the frequency offset estimate in the accumulator. When the frequency offset estimate is accurate, the DDFS perfectly compensate for the phase rotation due to the frequency output. Then the DD output is equal to zero and the PLL is stabilized (i.e., the accumulator stops increasing/decreasing the frequency offset estimate).

[0038] A selection diversity receiver employs M parallel diversity branches 67. A high level schematic/logic of a typical receiver using selection diversity [[65]] is illustrated in FIG. 6. FIG. 6 illustrates a typical wireless receiver comprising M parallel diversity branches 67, each comprising an RF down-converter 69 and a data ~~modulator~~

demodulator 71. Each diversity branch receives a time dependent signed S_m (t) 73. In a selection diversity receiver the signal of the diversity branch 67 with the highest instantaneous signal to noise ratio (SNR) selected 75 and input to the slicer 77.

[0040] A high level schematic/logic of a typical maximal ratio combining receiver is illustrated in FIG. 7. This receiver [[85]], like the selection diversity receiver, utilizes M parallel diversity branches 67 each comprising an RF downconverter 69 and a data demodulator 71. Each diversity branch receives a time dependent signal S(t) 73. The M diversity branches 67 output to a common slicer 77. However, instead of selecting the signal with the largest SNR as is the case with a selection diversity receiver, in a maximal ratio combining receiver, the signals 73 from all diversity branches 67 are co-phased 87 and weighted 89 according to their individual SNR (G_i coefficients 91) before being summed.

[0080] In a preferred fourth step 111, the highest instantaneous output value 109 of the matched filter/correlator is compared against a predetermined threshold 113. If the highest instantaneous output value exceeds the predetermined threshold value, code synchronization is accomplished 115. If the instantaneous output value does not exceed the predetermined threshold, code detection continues 117.

[0088] In a preferred second step, the mobile terminal ~~determining~~ computes the absolute value of a filter output 105 for each of the M diversity branch 67. Alternatively, other values that scale monotonically with the absolute value of a filter output including the magnitude square (power), the sum of the real and imaginary parts of the filter output, or any other approximation may also be computed.

[0090] In a preferred third step, the weighted/non-weighted output magnitudes 105, 123 determined in step [[1]] 2 are combined 125 thereby forming a weighted/non-weighted non-coherent combining diversity output value 127.

[0100] In a preferred fourth step, the co-phased and weighted values from the M diversity branches are combined 141, thereby forming a coherent combining diversity output value.

[0101] In a preferred fifth step, the real part of the coherent combining diversity output ~~value 143 is computed 145~~ value is computed 143.

[0103] Instead of a threshold comparison method, other methods, well known in the art, including maximum selection, multi-dwell, or multi-stage code acquisition may also be employed to determine whether code determination ~~has bee achieved~~ has been achieved.

[0109] In a preferred first step [[153]] 155 the mobile terminal determines and accumulates K partial code correlations for each diversity branch 67. In preferred second step 157, the mobile terminal Fourier transforms the ~~the~~ K partial code correlations in each diversity branch 67. In a preferred third step 159, the mobile terminal computes, for each of the M diversity branches 67, the absolute value of the Fourier Transform results for each of the P elements of the Fourier Transform vector.

[0117] In a preferred first step 155, the mobile terminal determines and accumulates K partial code correlations in each diversity branch. In a preferred second step 157, the mobile terminal Fourier transforms the K partial code ~~correslation~~ correlation in each diversity branch 67. In a preferred third step 159, the mobile terminal computes, for each of the M diversity branches 67, the absolute value of the Fourier Transform results for each of the P elements of the Fourier Transform vector.

[0119] In a preferred fourth step [[165]] 160, the mobile terminal combines, for each element p of the Fourier Transform magnitude vector, the values from the M diversity branches obtained in step 1, and creates a new non-coherent combining diversity FT vector $|X(p)|$.

[0127] In a preferred third step [[181]] 183, DD output of the selected branch is averaged over multiple DD output s.

[0128] In a preferred fourth step, [[183]] 171, the averaged DD value is used to compute the frequency estimate.

[0135] In a preferred second step 177, for each DD output (i.e., for each time index k), the mobile terminal combines 191 the DD output from the M diversity branches 67.

REMARKS

Claims 1-24 stand rejected in this application. No claims are added or cancelled by amendment. Accordingly, claims 1-24 are at issue.

The drawings stand objected to pursuant to 37 CFR 1.84 (p)(5). Substitute drawings are being submitted concurrently with this response. The substitute drawings are believed to address the objections stated in the Office Action.

The specification is objected to due to noted informalities. Substitute paragraphs are presented in this response to address these objections.

Claims 1-24 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over prior art identified in the specification. The rejection is respectfully traversed. It would not have been obvious at the time of the invention to use diversity techniques employed for data demodulation to achieve code synchronization because the prior art as a whole teaches away from such a combination. Known diversity receivers for data demodulation typically are used only after code synchronization has been achieved. Thus, the prior art as a whole teaches away from using diversity techniques *prior* to code synchronization.

In contrast, the present invention, as amended, claims processing the received signal by using at least two diversity branches to determine at least one diversity output prior to achieving code synchronization. The present amendment does not narrow the claims because prior to amendment, claim 1 and claim 12, by referring to "said received signal," also performed diversity processing before synchronization. The present amendment more clearly recites this requirement.

The statement that, "At the time of the invention, it would have been obvious to a person of ordinary skill in the art to incorporate in the code synchronization disclosed by the clock timing extraction circuit with the diversity technique disclosed by the clock

timing extraction circuit." is not well understood. The cited prior art does not disclose clock timing extraction in connection diversity reception. As set forth above, employment of known diversity techniques, as described in the written description, assumes that frequency offsets have already been determined.

Moreover, the stated motivation for the combination, i.e., to improve the quality of the data reception of a receiver, is inapplicable because code synchronization is not the same as data detection. For example, one problem affecting known techniques for code synchronization is the presence of frequency offset. Application, ¶¶ 0018-24. In CDMA receivers, frequency offset is corrected before diversity techniques are applied to data demodulation.

If the Examiner finds that there are any outstanding issues which may be resolved by a telephone interview, the Examiner is invited to contact the undersigned at the below listed number.

A check in the amount of $1020.00 to cover the petition for extension of time fee is submitted herewith. The Examiner is authorized to charge Deposit Account No. 23-0920 to cover any shortage of fees and requested to charge said charge account in the event that there has been an overpayment.

Respectfully submitted,
WELSH & KATZ, LTD.

By Walter J. Kawula
Walter J. Kawula, Jr.

Registration No. 39,724

May 19, 2006

WELSH & KATZ, LTD.
120 S. Riverside Plaza, 22nd Floor
Chicago, Illinois 60606
Phone: (312) 655-1500
Fax: (312) 655-1501